PATENT ABSTRACTS OF JAPAN

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(21)Application number : **03-312443**   (71)Applicant : **NEC CORP**
(22)Date of filing :   **27.11.1991**   (72)Inventor :   **ARIMA SHIRO**

(54) **PROGRAMMING SYSTEM OF MICROCOMPUTER**

(57)Abstract:
PURPOSE: To execute a program even if part of the memory of a microcontroller
becomes defective by rearranging plural programs and data on the memory.
CONSTITUTION: The memory consists of a ROM 2 stored with the programs and fixed
data and a RAM 3 stored with other data. The programs are multi- arranged on the
memory (in triple arrangement). Namelythe initial diagnostic routine 10 which performs
various initial setting processes and checks the operations of the ROM 2 and RAM 3and
the programs A11A'12and A"13 as actual programs are stored in the area of the ROM 2.
The programs A11A'12and A"13 are programs for the same process and the fixed data are
included therein. In the area of the RAM 3data 20 for the execution of the programs
A11A'12and A"13 are stored.

CLAIMS

[Claim(s)]
[Claim 1]A memory which stores a program and data.
CPU and a peripheral-control circuit which execute a program.
It is a programming method of a microcontroller provided with the aboveand multiplex
arrangement of said program is carried out on said memory.

[Claim 2]A memory which stores a program and data.
CPU and a peripheral-control circuit which execute a program.
It is the programming method provided with the aboveand multiplex arrangement of said
program and said data is carried out on said memory.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the programming method of a

microcontroller.

[0002]
[Description of the Prior Art]The conventional programming method arranged a program and data to the beforehand fixed single field on a memory.

[0003]
[Problem(s) to be Solved by the Invention]Howeverin this conventional programming methodin order to arrange a program and data to the beforehand fixed single field on a memorywhen a defect arose in the memory equivalent to that fieldthere was a problem that execution of a program became impossible.

[0004]Thentechnical SUBJECT of this invention is providing the programming method of the microcontroller which can execute a programeven if a defect arises in a part of memory of a microcontroller in view of the above-mentioned fault.

[0005]
[Means for Solving the Problem]In a programming method of a microcontroller which has a memory which stores a program and dataCPU which executes a programand a peripheral-control circuit according to this inventionMultiplex arrangement of said program is carried out on said memoryand a programming method of a microcontroller characterized by things is obtained.

[0006]In a programming method of a microcontroller which has a memory which stores a program and dataCPU which executes a programand a peripheral-control circuit according to this inventionMultiplex arrangement of said program and said data is carried out on said memoryand a programming method characterized by things is obtained.

[0007]That isa programming method of this invention carries out multiplex arrangement of a program or a programand the data on a memory.

[0008]
[Example]Nextthe example of this invention is described with reference to drawings.

[0009]Drawing 1 is a block diagram of the microcontroller 100 of one example of this invention. The peripheral-control circuits 4 are a timeran I/O controlleretc. A memory comprises ROM2 which has stored a program and fixed dataand RAM3 which store data in addition to this. CPU1 executes a program with reference to ROM2 and RAM3controlling the peripheral-control circuit 4.

[0010]Drawing 2 shows the example of a memory map at the time of carrying out multiplex arrangement of the program (3-fold arrangement). The program A11 and the program A'12 which are the initial diagnostic routine 10 which performs the operation check of various initialization processings and ROM2and RAM3and a actual programand program A''13 are stored in the field of ROM2. The program A11the program A'12and program A''13 are the programs of the same processingand also contain fixed data in it. In performing the program A11the program A'12and program A''13the field of RAM3 stores the data 20.

[0011]Drawing 3 is an example of a flow chart of processing of drawing 2. With the initial diagnostic routine 10the operation check of ROM2 is performed (Step S1)and if the field of the program A11 is normalthe program A11 will be executed (Step S2). If ROM2 of the field of the program A11 is not normalthe field of the program A'12 will be judged (Step S3)and if normalthe program A'12 will be executed (step S4). Similarlyif ROM2 of the field of the program A'12 is not normalit will judge about the field of program A''13 (Step S5)if normalprogram A''13 will be performed (Step S6)and error

handling will be performed if not normal (Step S7).

[0012]Usuallythe operation check of the ROM area writes checksum data in the object domain beforehandand judges whether it is normal by the result of an operation so that all the field data may be calculated (exclusive OR or addition) and it may be set to 0.

[0013]Drawing 4 shows the example of a memory map at the time of carrying out multiplex arrangement (3-fold arrangement) of a program and the data.

[0014]RAM3 is divided into the data A21the data A'22and the data A"23and it uses it respectively as a field which stores the program A11the program A'12and the data of program A"13. Except itit is the same as that of drawing 2.

[0015]Drawing 5 is an example of a flow chart of processing of drawing 4.
In addition to the operation check of ROM2the operation check of RAM3 is also carried out simultaneously and performs the program A11 with each normal field where ROM2 and RAM3 correspondA'12and A"13.
Except itit is the same as that of drawing 3.

[0016]Namelywith the initial diagnostic routine 10perform the operation check of ROM2 (Step S11)and if the field of the program A11 is normalThe operation check of RAM3 is performed (Step S12)and if the field of the data A21 is normalthe program A11 will be executed (Step S13). If ROM2 of the field of the program A11 is not normalthe field of the program A'12 will be judged (Step S14)if normalthe field of the data A'22 will be judged (Step S15)and if normalthe program A'12 will be executed (Step S16).

[0017]Similarlyif ROM2 of the field of the program A'12 is not normalwill judge about the field of program A"13 (Step S17)and if normalThe field of the data A"23 is judged (Step S18)if normalprogram A"13 will be performed (Step S19)and error handling will be performed if not normal (Step S20).

[0018]The check of a RAM area reads by writing in dataand is usually performed by comparing the contents of data.

[0019]
[Effect of the Invention]As explained abovesince this invention carried out multiplex arrangement of a program or a programand the data on the memoryeven if a defect arises in a part of memoryit has the result that execution of a program is attained.

[0020]In particularthe memory of a microcontroller has large-scale-ized and the programming method of this invention is effective now.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a block diagram of the microcontroller of one example of this invention.
[Drawing 2]It is an example of a memory map in the case of having arranged the program three-fold by drawing 1.
[Drawing 3]It is an example of a flow chart in the case of having arranged the program three-fold by drawing 1.
[Drawing 4]It is an example of a memory map in the case of having arranged a program and three-fold data by drawing 1.
[Drawing 5]It is an example of a flow chart in the case of having arranged a program and three-fold data by drawing 1.

[Description of Notations]
100 Microcontroller
1 CPU
2 ROM
3 RAM
10 Initial diagnostic routine
11 Program A
12 Program A'
13 Program A"
20 Data
21 Data A
22 Data A'
23 Data A"